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Nebraska Minerals Which Excite Common Inquiry

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ERWIN HINCKLEY BARBOUR, State Geologist

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NEBRASKA MINERALS WHICH EXCITE COMMON INQUIRY

BY

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NEBRASKA MINERALS WHICH EXCITE COMMON INQUIRY

BY ERWIN H. BARBOUR

The Minerals, Rocks, and Fossils of Nebraska, which Excite Common Inquiry, are treated brefly in leaflets numbered 37, 37a, 37b, respectively. These are intended to serve as circular letters to correspondents. Possibly they may prove to be acceptable and helpful in a measure to teachers and others who conduct parties of school children on field excursions.

A leaflet on the subject "Minerals Which Excite Common Inquiry" is rendered imperative by the number of letters received at the office of the Nebraska Geological Survey asking for information about coal, oil, gas, gold, iron pyrite, mica scales, garnet grains, magnetic sand, supposed meteorites, iron ore, materials for abrasion, and the like. Such a paper offers advantages over personal letters, as it can enter more fully into detail, can be sent to correspondents by return mail, and gives suggestions relative to simple laboratory methods to be tried at home. The tests are so simple that school children can make them successfully.

It must be remembered that the rocks of Nebraska are level, undisturbed sediments which are usually deeply blanketed and concealed from view by sand and soil. There are no mountains, no crystalline rocks, no uplifts, dikes, or veins, accordingly there are few minerals throughout this great territory. The common minerals in nature are few in number, simple in composition, and are easily identified and remembered. There is state-wide and world-wide demand for knowledge respecting them. Every school in America should afford its students an opportunity to acquire some knowledge of minerals since they constitute the sole basis of all industries, activities, and even existence itself.

Unfortunately, in the West, the word mineral has acquired the restricted meaning, gold-bearing or silver-bearing. In a broader and better sense, a mineral is any natural inorganic substance of homogeneous composition found in or upon the earth, which is not made by animals or plants. This definition covers about 1,000 known minerals. This is not so formidable an array as may appear at first sight, for only 35 or 40 of these are of importance either commercially or geologically.

The really common minerals are fewer in number than the letters of the alphabet, while the very commonest are but eight. These eight constitute practically all of the globe. The minerals of first importance are but three, quartz, feldspar, and calcite. The soils which we cultivate, the clays which we burn, and the rocks which we quarry are composed essentially of these three, and they at least should be known by everyone.

Since the number of minerals native to Nebraska are few, little apparatus is necessary for their determination. It is desirable to be provided with a magnet, knife, hammer, and streak stone. Any hard white whetstone, bit of porcelain, or unglazed tile may serve as a streak stone. By rubbing the mineral on this the streak or mark is obtained, just as the streak or mark of graphite in a lead pencil is obtained by rubbing it on paper. About the only reagent necessary is a little vinegar, or, better still, a little hydrochloric acid mixed with an equal amount of water.

DIAMOND

Diamond is pure crystallized carbon. Of all known substances it is the hardest, and this physical property is its most reliable test. It crystallizes in the form known as the octahedron, or the eight-faced crystal, the edges of which are commonly rounded. Hold a supposed diamond with one point or apex upward, and if you can count four triangular faces above and four below, it may be a diamond. Quartz crystals, so commonly mistaken for diamond, are readily distinguished because they show six faces above and six below and generally six faces between.

A good test follows: if the supposed diamond readily cuts any of the minerals which scratch glass, such as quartz, flint, and the like, it should be sent without fail to the State Geological Survey for determination.

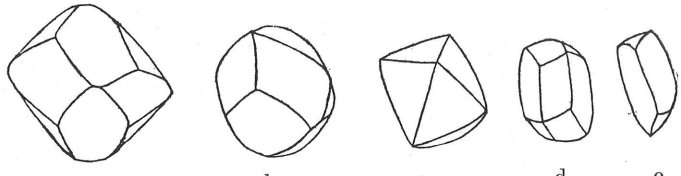


Fig. 1.—Diamonds found in glacial drift in the United States, approximately natural size, after Hobbs. a, from Eagle, Wisconsin, 16 carats; b, from Saukville, Wisconsin, 6½ carats; c, from Milford, Ohio, 6 carats; d, from Oregon, consin, 4 carats; e, from Burlington, Wisconsin, 2 carats.

Some ten or twelve fine diamonds have been found in the glacial drifts of Wisconsin, Michigan, Indiana and Ohio, and their occurrence in the glacial drift of Nebraska, though not probable, is not impossible. As yet they are unknown to the State, and are mentioned solely because transparent pebbles and crystals of quartz are so often sent to this office with the hope and expectation that they are diamonds.

GOLD

Gold is a native element, and is the most highly prized of all metals. It is assumed that description is unnecessary because it is universally known. It is so closely imitated by "fools' gold," described under Pyrite, that many citizens of the State very naturally confounded the two. In a like manner, mica scales, at a certain stage of weathering, are golden and deceive many people. Place the grains supposed to be gold upon the face of a common smoothing iron, and pound or rub with a hammer. If gold, the grains will flatten into unmistakable shining scales of the pure metal; if pyrite or golden mica, they will be reduced to powder. This ought to be final, and probably no further test will be necessary. Gold is also recognized by the fact that no single acid acts upon it.

Gold is widely distributed over the earth, but in paying quantities must be sought in the proximity of mountains where there are gold-bearing veins. Gold seldom occurs combined with other minerals. It is generally found as free or native metal, in the form of nuggets or strings, or as flour-gold, invisible to the eye. When gold-bearing rocks break down under the action of atmospheric agents, the grains of pure gold are liberated, become included in the sand of adjoining valleys, and constitute the placer deposits which used to be panned with such profit. Gold is heavy for its specific gravity is 19. Accordingly it settles quickly and cannot be carried by streams far from the mother vein. It is by virtue of this high specific gravity that gold can be separated from sand by panning. It is about eight times as heavy as common sand. Analyses often show traces of gold in sands of the Platte and other rivers, and likewise in our glacial drift, which covers the eastern fifth of the State. Even traces of gold are interesting, but no optimism can greatly alter the belief of geologists that "pay dirt" is not to be found in Nebraska.

Just why people are subject to gold excitements, and pay such tribute to gold taken from mines, while they so little appreciate the gold derived from the industries and arts, is hard for geologists to fully under-

stand. Gold derived from agriculture, the industrial arts, and applied sciences is just as good, just as honorably obtained, and there is vastly more of it. The clay workers alone of the United States obtain more gold and silver annually than do the miners of the two precious metals, gold and silver. Gold-like minerals will be discussed under Pyrite and Golden Mica.

SILVER

Silver, which is the next most highly prized metal, is a native element. One variety of pyrite is a pale silvery color, and mica scales, in some instances, have a silvery metallic luster. These minerals often excite curiosity and hope. Like gold, silver is heavy and malleable, and the test recommended for gold can be applied in making a home test for silver. Silver excitements, though rare, are occasionally recorded in Nebraska, but as yet silver occurs simply as traces.

COPPER

Copper is also a native element. Several bits of pure copper have been found in the State, and one piece weighing perhaps two ounces is preserved in the Nebraska State Museum. This is supposed to have been transported to the State along with the glacial drift, or possibly it was carried by the early Indians from the Lake Superior region, and accidentally dropped in Nebraska. The occurrence of copper is often reported, but careful examinations show that many mistake the coppery luster of pyrite crystals and nodules for actual copper.

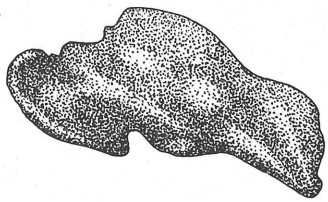


Fig. 2.—Two-ounce nugget of native copper, Cheyenne County.

The test is easy. Copper is malleable under the hammer, and is sectile under the blade of a knife. Pyrite, which in some cases shows a coppery semblance on weathered surfaces, is brittle under the hammer, and not sectile. Copper nuggets frequently reported from the Sioux and Dawes county bad lands prove to be cubes of pyrite with a copper-colored tarnish.

GALENA, LEAD ORE

Galena is sulphide of lead in the proportion of sulphur 13.4 parts, to lead 86.6, and is the most important ore from which lead is smelted. It has been reported from two localities, Wymore and Plattsmouth. That cubes of galena have been found in the State is certain, but none have been found in place, as far as can be learned. It is believed that those found are not native in Nebraska but have been transported. Galena looks like metallic lead, but differs in that it is brittle, and breaks into small cubes. This is the first, as well as the simplest, test for the mineral. This test ought to be conclusive, for there is no other metallic mineral found in Nebraska which cleaves in cubes.

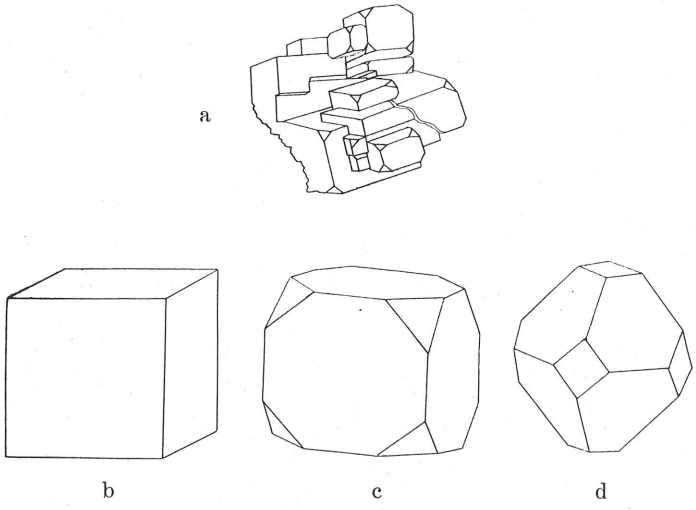


Fig. 3.—Galena crystals. a, group of galena cubes as taken from the mine; b, an ideal galena cube; c, cube and octahedron combined; d, cubo-octahedron.

A second test, which is highly satisfactory and determinative, is to melt a few grains on a bit of broken china laid on hot coals. If galena, sulphurous fumes will be given off and a bead of unmistakable lead will be obtained. No other mineral in the State will give like results.

SPHALERITE, ZINC ORE

Sphalerite, also called black-jack and zinc blende, is sulphide of zinc. It is the principal ore from which the well-known metal zinc is extracted. In the majority of cases where zinc blende has been re-

ported, the samples do not prove to be authentic; the presumption is, therefore, that bits were transported from some other locality. One sample of zinc blende found near Humboldt, is scarcely the size of a pin head, and occurs as an inclusion in a marcastic nodule. Sphalerite has a dark waxy or resinous luster and there is no other simple test. Anyone suspecting he has found sphalerite should submit it to the State Survey for determination.

IRON ORE

Iron ore is the basis of all modern civilization. Hence it is of the utmost importance. While iron ore in paying quantities cannot be hoped for in Nebraska, nevertheless enough occurs to attract attention and make an explanatory word necessary. In Chapter 58, Compiled Statutes of Nebraska for 1905, will be found an offer of "two thousand dollars to be paid for a vein of iron ore eighteen inches thick," payment to be made out of the general funds of the State Treasury. Remember iron is the universal stain in nature. Clays, sands, and rocks which are red or yellow, are so because colored by red or yellow iron rust. But materials colored thus are not "iron ore" as some people think.

The following simple classification includes all of the commercial iron ores and may be helpful and suggestive:

Iron ores
- Golden iron ore, called Pyrite
- Red iron ore, called Hematite, or Red Ochre.
- Yellow iron ore, called Limonite, or Yellow Ochre
- Black iron ore, called Magnetite
- Gray iron ore, called Siderite
- Native Prussian Blue, called Vivianite.

IRON PYRITE, GOLDEN IRON ORE

Iron Pyrite, known everywhere as "fools' gold," is sulphide of iron in the ratio of 46.6 parts of iron to 53.4 parts of sulphur. Crystals of pyrite, when small and scattered through any matrix, are highly imitative of actual gold, and it is well for professional geologists themselves to look twice before passing positive judgment. One who is not a mineralogist may try these simple and easy tests: Put a few bits of the golden mineral on an old flatiron, and pound with a hammer. If pyrite, they will be reduced at once to powder, while if gold they will be reduced to flat unmistakable metallic scales.

No other test is necessary, but as a second or confirmatory test, drop some of this powder on a hot stove lid, or roast on a fire shovel, or on

a piece of broken china laid on the coals, and note if the golden grains turn black, a change showing the sample to be pyrite. Gold would not change. During the process of roasting, one may smell the sulphur which is driven off. When roasted to blackness, test with a small horseshoe magnet, and it will be found that the grains have become magnetic, proving they are iron, not gold.

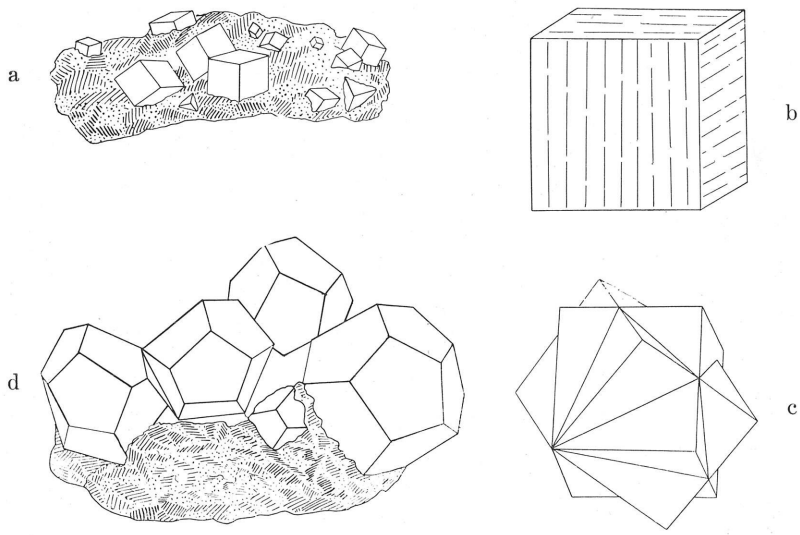
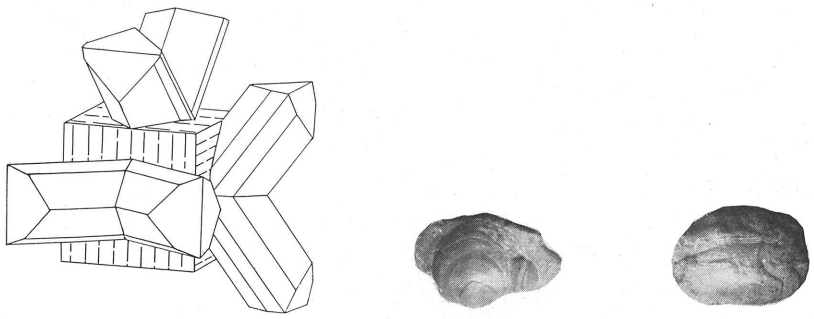


Fig. 4.—Pyrite crystals, "fool's gold." a, golden pyrite cubes on stone; b, golden pyrite cube showing striae; c, two interpenetrating cubes of pyrite; d, pyritohedrons of fool's gold on matrix.

Iron pyrite is of universal occurrence in sands, clays, and rocks. Rocks containing even small amounts of pyrite are undesirable for structural purposes because pyrite weathers easily, and in so doing forms streaks of iron rust. In certain mountain regions pyrite occurs in extensive masses, and was once the source of sulphuric acid and sulphur. Occasionally "fools' gold" carries enough real gold to pay for smelting.

MARCASITE, GOLDEN IRON ORE

Marcasite is the same as pyrite and need not be mentioned save that it is common in the form of nodules. It does not crystallize in cubes like pyrite, is not so golden, and tends to go to pieces quickly. Chemically it is the same as pyrite.



a b

Fig. 5.—Marcasite. a, marcasite crystals on a striated cube of pyrite; b, common marcasite nodules.

Hematite, Red Iron Ore

Hematite, or red iron ore, is oxide of iron in the proportion of oxygen 30 parts to iron 70. This is the most important and one of the richest ores of iron, and is the chief source of the iron and steel of commerce. Modern civilization is based primarily upon this one mineral.

Reduce a bit of the mineral to fine powder by pounding, then rub on white paper. If it makes a blood-red streak, it is unmistakably hematite, for there is no other mineral found in Nebraska which will give such a streak. As an additional test, roast some of the powder on a kitchen shovel, old iron spoon, or bit of china, and if it changes from red to black and becomes magnetic, it may be pronounced hematite.

When occurring in nature in a powdery form, it is called red ochre. Soft, compact varieties, called red chalk or keel, are often cut into pencils and used for marking boxes and bags. Hematite occurs sparingly in Nebraska. It is of interest but not of value. "Hematite balls" are fairly common and may be accounted for thus: fools' gold, of the variety called marcastic, commonly occurs in rounded nodules, the surface of which undergoes rapid alteration when exposed to atmospheric action. When heated by any chance this surface is converted into hematite.

Limonite, Yellow Iron Ore

Limonite, known also as brown hematite, yellow iron ore, and yellow ochre, is hydrated oxide of iron in the proportion of water 14.5 parts, oxygen 25.7 and iron 59.8. It is heavy and of a dark rusty color. Clays and sands stained with limonite are not to be mistaken for an

ore. The best general test, if you lack a streak stone, is to reduce the sample to fine powder with a hammer, and rub on white paper. If it leaves a yellow ochreous streak, it is limonite. The color of ochre is universally seen in the dirty yellow priming coat of wooden structures. If additional tests are desired, heat some of the powder to redness on a common shovel, or on a bit of broken china, and it will turn black, and become magnetic, which proves it is iron. When occurring in a powdery form, it is called ochre. Around Indianola extensive beds of sandy ochre have long been known, and at one time ochre mills were in operation there. A variety of colors may be produced from common yellow ochre by roasting.

Rusty balls or concretions of iron are found abundantly wherever the Dakota formation is exposed in this State. They consist of sand firmly cemented together by iron oxide, generally limonite, and on fresh fracture resemble cast iron, for which they are commonly mistaken. These balls vary from round to irregular, and attain considerable size. In some cases the walls are extra thick, and their similarity to rusty cast iron is very striking. This is not "iron ore," nor has it been "melted," nor is it "lava"; it is simply sand intimately cemented by oxide of iron.

MAGNETITE, BLACK IRON ORE

Magnetite, or black iron ore, is oxide of iron in the proportion of oxygen 27.6 parts, to iron 72.4. It is a very rich ore, is heavy, and can be panned like gold. A sure and easy test lies in the common magnet, or a magnetized knife blade, to which the black grains fly like iron filings. This is a conclusive test because no other mineral in the State will give like results. Magnetic iron sand has caused a great deal of speculation, and has brought to this office many letters of inquiry. Being jet black it stands out prominently against the sand in which it is commonly found. Magnetic sand is twice as heavy as ordinary sand.

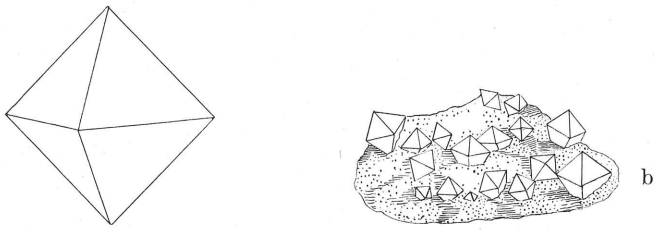


Fig. 6.—Magnetite crystals. a, eight-faced crystal of magnetite; b, group of magnetite crystals on rock.

Accordingly it settles more quickly in running water, and for this reason occurs in assorted pockets and layers. Magnetic sand occurring in large amounts has value, but in Nebraska it is of interest rather than use.

METEORIC IRON

Except in rare instances, iron in nature does not occur as a pure metal. It does occur as pure iron in meteorites, which are generally black on the surface and are irregularly rounded, and pitted. These have fallen from outer space onto the earth. They may be instantly recognized by the finder as iron, for the color, texture, and weight is that of iron, and the filings are attracted by the magnet. Meteoric iron is of rare occurrence and anyone finding a meteorite should report the same to the State Geologist, who will estimate its value.

Two substances are very commonly confounded with true meteorites. One is the hard quartzite boulders so common in the fields of eastern

Fig. 7.—Iron meteorite. a, from Red Willow County, approximately one-half natural size; b, surface polished and etched to show crystallization in the iron (Widmanstätten figures).

Nebraska. Because rounded and of a reddish color, they are popularly believed to have been heated; and since they are often half buried in the sod, they are generally thought to have fallen from the sky. The inference is that they are meteorites. Only four meteorites have been found in the State. They are pure iron, and are unmistakable.

Quartzite will scratch glass. Meteoric iron will not. This is the simplest test and ought to enable anyone to distinguish between them.

Another substance often mistaken for meteorites is found in the ash of burned stacks of hay and straw. It is a bubbly, glassy, lava-like

mass formed by the fusion of silica, soda, lime, and iron, in the straw. Some draw the inference that a falling meteorite set fire to the stack, and that the slag found in the ash is the meteorite.

VIVIANITE, NATIVE PRUSSIAN BLUE

Native Prussian Blue, or blue iron earth, known in mineralogy as vivianite, is iron phosphate in the proportion of iron 43 parts, phosphorus 28.3, and water 28.7 parts. This mineral occurs in considerable abundance between layers of Cretaceous shale in the Republican Valley, and is recognized at once by its bright indigo-blue color. Children in this region pulverize and use it as blue ink and blue paint. In places, it occurs as vividly yellow nodules, and in other places, it is yellow without, and blue within. There is no indigo-blue mineral in Nebraska with which it can be confounded. Tooth turquois is rare in the State and is robin's egg blue. It is soft, is dissolved by hydrochloric acid, and fuses easily into a globule which is attracted by the magnet, showing it is iron.

TURQUOIS

Turquois is hydrous aluminium phosphate. Three small bits of turquois have been found in Brown County. One of these made a handsome stone when cut and mounted by a Boston lapidary. They are apparently the variety known as tooth or bone turquois, odontolite. Bones, teeth, and the tusks of mammoths, mastodons, and other animals are in some instances converted into turquois. The blue color is due to phosphate of iron. This gem stone seems worthy of more admiration than any other produced in the State. Any mineral whose color is a fine robin's egg blue should be submitted to this office for examination Odontolite has an organic origin, hence, according to the preceding definition, is not strictly a mineral, and yet it is bone or tooth so highly mineralized that it may be conveniently classed as such.

HALITE, ROCK SALT

Halite is common salt occurring in masses like rock. In certain places it occurs in thick beds of broad extent. Since it is readily soluble, it is always tested by a touch of the tongue. While rock salt is mined extensively in Kansas, it does not occur in Nebraska save in salt water. It is confined to the vicinity of Lincoln where the salt springs are found. These were set aside by the commonwealth as inalienable and were known as the State Saline Lands. Prior to the discovery of the great beds of salt in Kansas, the production of this mineral from the saline lands of Nebraska was a flourishing industry. Many of the common

surface wells, and all deep wells, in southeastern Nebraska, tend to be saline. When the salt flats west of Lincoln dry up, a white encrustation, consisting chiefly of salt, covers the ground and crystallizes upon grass, leaves, and twigs.

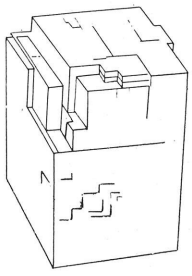


Fig. 8.—Halite, rock salt. Showing cubic cleavage.

ALKALI

The alkali lakes are located mostly in the sand-hill region, and should be called ponds or lakelets. Those best known are located in Sheridan, Cherry and Brown counties. Alkali, like salt, is detected by the sense of taste. During certain dry seasons, the waters of some of these lakes are greatly concentrated, and some are dried up altogether, and the lake beds are then covered with a thick white efflorescence called "alkali crystals." This crude alkali can be easily raked up at such times. Certain parties have been shipping this encrustation for a number of years. Several attempts have been made to extract these salts commercially, for they are even found deep in the lake bed itself. At present, there is a small alkali mill in operation near Alliance.

It might be explained, perhaps, that the word "alkali" includes the salts of soda, potash, and the like. A number of salts are prominent, namely: carbonate of soda (soda ash), bicarbonate of soda (cooking soda), and some sodium chloride (common salt). Of the potash salts, there are potassium carbonate, potassium sulphate, and potassium chloride. These are the principal salts contained in the efflorescence around the margins of the alkali ponds and lakes. The crude alkali is said to be worth about $20 a ton, whereas some of the salts, when separated and refined, are worth $80 to $100 a ton. Alkali is a valuable resource, and if properly developed might mean millions of dollars to Nebraska, for there is an abundance of material, the uses to which it is put are many and varied, and the market is exceptionally good.

PYROLUSITE

Pyrolusite is black oxide of manganese in the proportion oxygen 36.8 parts to manganese 63.2. This mineral is scattered sparingly throughout the State. In some places it occurs in amounts sufficient to attract public attention. In other places, it occurs as round black nodules like black walnuts, or as a black coating to sand. In most places it is a delicate black tracery, imitating ferns or miniature trees, on rocks and clays. The last mentioned are called dendrites, which means tree-stones.

The test for pyrolusite is its blackness and softness. It will make a black streak on paper, and is generally soft enough to blacken hands and fingers. It cannot be confounded with any other black mineral found in Nebraska, for black iron ore is hard, heavy and magnetic, and coal is too universally known.

The black moss-like figures which make our moss agates so attractive are due largely to pyrolusite. In one place pyrolusite is reported to occur as hard-pan sufficiently thick to offer considerable

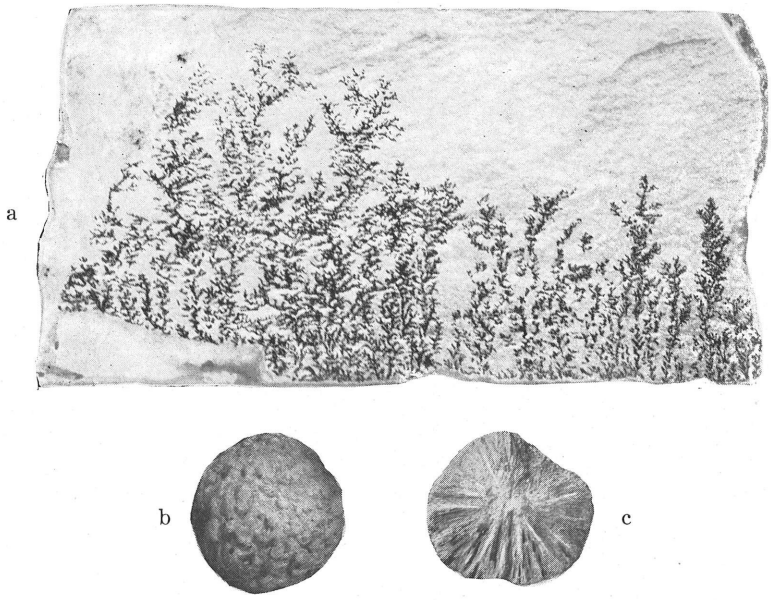


Fig. 9.—Pyrolusite. a, Dendrite or "tree-stone" (fern-like traceries of black oxide of manganese) on Carboniferous limestone; b, a nodule of pyrolusite from Cheyenne County; c, same broken to show radiated structure.

resistance to the plow. Although very useful in the arts, especially in the production of manganese steel and the clarification of glass, it no longer has a high market value. Its occurrence in Nebraska is of no commercial consequence. The Greek name pyrolusite is interesting for it means to "wash by fire," that is when added to melted glass it "washes out" the color and leaves the glass clear.

QUARTZ

Quartz is the commonest mineral in nature, and constitutes the base of all sands, gravels, soils, and sandstones. It is silicon dioxide in the ratio of 53.3 parts of silicon to 46.7 parts of oxygen. Quartz crystals are occasionally found, but quartz pebbles are abundant. As far as the untrained eye can judge, many pieces of quartz are as pure, transparent, and sparkling as diamond itself, for which it is often mistaken. When cut in diamond form it seems quite as brilliant and

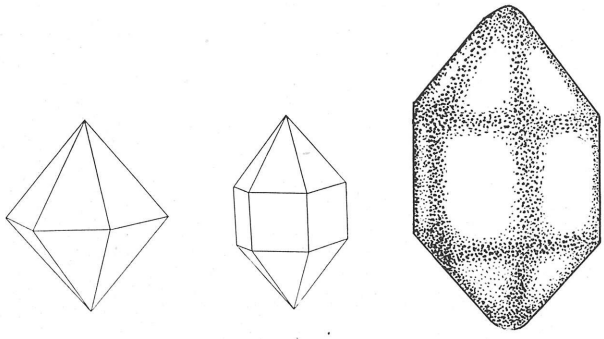


Fig. 10.—Quartz crystals. a and b, types found at Wymore and Blue Springs x 4; c, water-worn quartz often found in stream gravel, and commonly thought to be diamond, x 2.

sparkling. However, quartz grows dull with use, while diamond does not. As a test for quartz this simple rule is standard: Any mineral found in Nebraska, irrespective of its color, which is hard enough to scratch glass, may be pronounced one of the many varieties of quartz. Many people have sent the transparent and yellow sorts to lapidaries and have had interesting, if not beautiful, semigems cut. Transparent quartz is often called rock crystal; the dark variety, smoky quartz; the yellow, false topaz, or citrine; and the lilac colored, amethyst.

QUARTZ, VARIETY CHALCEDONY

One variety of quartz known as chalcedony occurs abundantly in our drift as pebbles. Further west in the State, it is occasionally found in interesting concretionary and stalactitic forms, and in our bad lands as thin sheets and dikes. It has a waxy or oily luster, and is generally tinted yellow. Select bits, when properly cut and mounted, make gem stones which find ready sale. Many have been cut and sold in southeastern Nebraska.

QUARTZ, VARIETY MOSS AGATE

Moss Agate is found in considerable abundance especially in northwestern Nebraska. The "moss" consists of black oxide of manganese arranged in mossy or tree-like forms. This agate is often cut and

Fig. 11.—Moss agate. a, an Indian scraper chipped in moss agate, natural size; b, moss agate from Agate, Nebraska, cut into a charm, x 2.

mounted to good advantage, and is a semigem of considerable beauty and worth. As yet these deposits of moss agate have no commercial value.

QUARTZ, VARIETY FLINT

Flint is that variety of quartz which occurs as hard, dark, irregular nodules in many places in our limestones. It is readily recognized by the following simple characters. It cuts glass, breaks with conchoidal fracture, strikes fire with steel, or when two pieces are struck together. At Wymore and Blue Springs, the layers of flint nodules in the Permocarboniferous thicken and practically coalesce into a nearly solid layer about twenty feet in thickness. This is worked into ballast

by three large crushers, two of which produce and sell large quantities. Flint was used extensively by the early Indians of America for making arrow points and spear heads. It was once commonly used for flint-lock guns and pistols.

GARNET

Garnet is a complex silicate of lime, magnesia, alumina and iron Grains of garnet are not uncommon in the sands of the State, and by working diligently a considerable number of small water-worn crystals, and fragments of sufficient size to warrant mounting, can be found. Though mostly small and fragmentary, they are of good color, and when cut make attractive gems which are interesting because native. The only simple test for a garnet is its color. The following character-

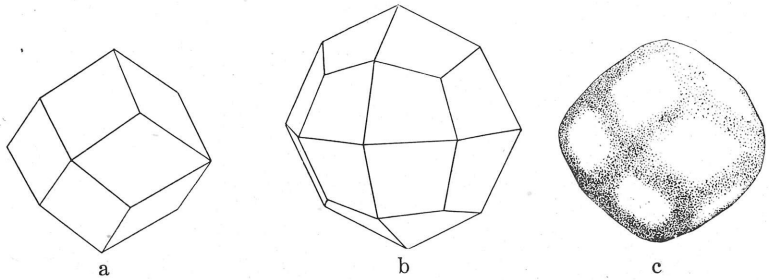


Fig. 12.—Garnet crystals. a, twelve-faced garnet; b, twenty-four-faced garnet; c, water-worn garnet, common in our glacial drift.

istics will aid in recognizing it: Garnet is relatively heavy and can be "panned" out of sand by exercising care; it is hard, and readily scratches glass; and its color ranges from pinkish to a dark transparent red. These characteristics ought to be sufficient for its identification. There are no minerals in our State with which garnet can be confounded.

GOLDEN AND SILVERY MICA

Mica is known everywhere as the substance used in stove doors. It is generally sold under the misleading name isinglass. Mica scales, when minute and mixed with clay or sand, often reflect light in such a way that they imitate flecks of gold or silver. For this reason many citizens are led to submit samples for determination. If a little such material be put in a bottle or fruit jar filled with water, and shaken, the glint of golden or silvery grains can be plainly seen while the particles are slowly settling. If the glistening scales were gold or silver, they

would go to the bottom at once. This is a sufficient test, but it might not be amiss to test for malleability as directed under gold.

When the grains are large enough to be visible to the eye, it is possible to test them in the following simple way: with a pin or needle, pick apart and split into as many scales as you can. Those who have put "isinglass" in stove doors know how preeminently cleavable mica is. It can be split into a seemingly unlimited number of thin plates. Accordingly if the glistening scales split or cleave readily, they are probably mica, for neither gold nor silver cleaves. Mica is not a native mineral. Scales of mica were carried into the State by wind, streams, and ice. Many mica-bearing rocks, such as mica schist, and mica granite, were brought here in this manner. When sufficiently weathered, these rocks disintegrate and liberate the golden and silvery mica scales which many confuse with rare metals.

FELDSPAR

Feldspar is a complex silicate of aluminum, iron, lime, and potash. It is counted by some the most important mineral because it is the source of clay and soil. The simple tests for feldspar are color, hardness, and cleavage. Its color is white, pinkish to red, and very commonly flesh-colored. When struck it breaks, or cleaves, showing smooth flat faces. No other hard mineral found in Nebraska will do this. It is sufficiently hard to scratch glass, but is barely scratched by a file. There are but three hard minerals found in the State, namely,

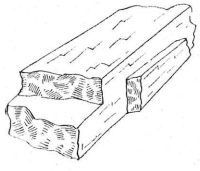


Fig. 13.—Common feldspar. Top and sides show planes of good cleavage at right angles, while the ends show very poor cleavage.

quartz, feldspar, and an occasional bit of garnet. Quartz is more or less clear and glassy, cuts glass with a deep scratch, and never breaks with flat faces because it has no cleavage. Feldspar is seldom clear and glassy. It scratches glass slightly, and breaks with cleavage faces. These simple physical properties should enable people to distinguish between quartz and feldspar. In certain gravels feldspar is prominent. It is not native but has been transported by ice or flood.

FELDSPAR, VARIETY AMAZONSTONE

Amazonstone is a beautiful verdigris-green variety of orthoclase feldspar. It has a fine green color, and cleaves like ordinary feldspar. It is hard enough to scratch glass if some force is used. It is safe to say that any hard green mineral which cleaves is amazonstone. It is not native to Nebraska, but is found in certain gravels in pieces the size of walnuts or less. Good pieces may be cut into semigems, which are well worth the moderate charges of the lapidary.

BARITE, HEAVY SPAR

Barite, or heavy spar, sulphate of baryta, occurs sparingly in western Nebraska, in the Hat Creek Bad Lands, in Gage County, and elsewhere. There is no simple test for barite save its weight and the

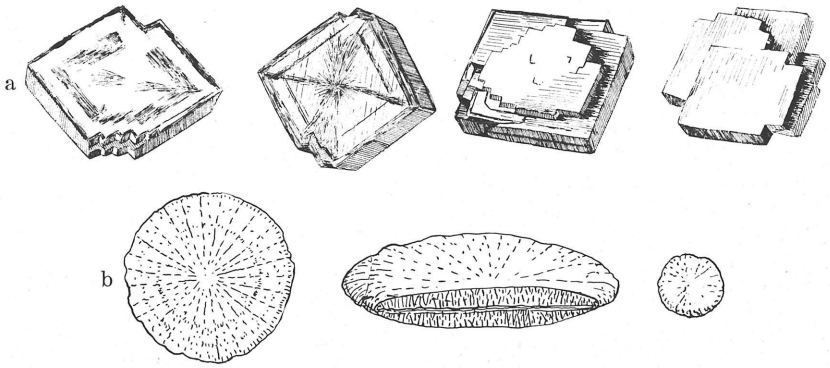


Fig. 14.—Barite, Heavy Spar. a, Barite crystals from the "Diamond Fields" near Odell, Nebraska, x 3. Some show phantom figures; b, Barite "dollars." Common in the Cretaceous shales near Bloomington. Noticeably heavy.

shape of its crystals. In Gage County the crystals are recognized because "diamond shaped," hence the spot near Odell, where they are found in considerable numbers, is called the "Diamond Fields."

CELESTITE

Celestite, strontium sulphate, is a rare mineral in Nebraska, although some small but very interesting crystals have been found in the geodes so common at Blue Springs and Wymore. Celestite crystals are readily distinguished because they are long, slim prisms belonging to the orthorhombic system, and their color is a beautiful pale blue. The geodes containing them are lined with small white crystals of calcite

and quartz, and the celestite crystals, though less than half an inch long, stand out clearly against this white background. There is no simple test, and the mineral has no value. It should be stated, however, that the geodes containing any of these crystals find ready sale, and should all be preserved. Veins of reddish celestite are reported in Kansas very near the Nebraska line, and it is safe to predict that the same will be found in this State. These veins are a mass of crystals, and are several inches in thickness.

SELENITE, GYPSUM CRYSTALS

Selenite is sulphate of lime. It is simply a refined variety of gypsum, the well known source of plaster of Paris. When gypsum, or gyp, as it is sometimes called, is crystallized it is called selenite. Gypsum rock, so common in neighboring states, is wanting in Nebraska, but selenite crystals are common. In certain portions of the State, particularly where Cretaceous shale outcrops along the Republican River in southern Nebraska, in the Hat Creek basin in northwestern Nebraska, along the Niobrara and the Missouri in northeastern Nebraska, selenite or gypsum crystals are very abundant.

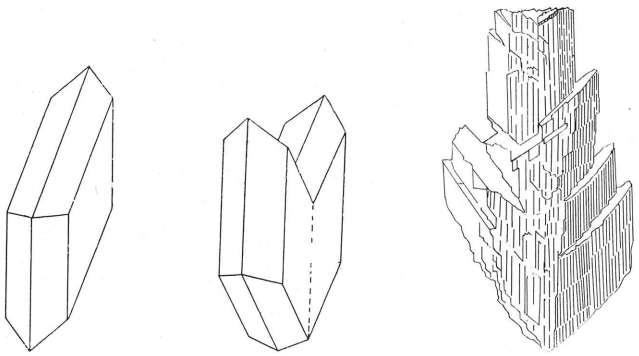


Fig. 15.—Gypsum crystals (selenite). a, common form of gypsum crystal; b, two crystals twinned; c, fish-tail or spear-head twins.

These crystals cleave readily into mica-like scales, for which they are generally mistaken. However, they are easily distinguished in the following way: mica is elastic, that is when bent it springs back into place, but selenite is inelastic and does not. It bends but does not snap back. Furthermore selenite occurs in rather large crystals, and cleaves into good sized sheets while mica in this State is always in small

scales. Selenite is so soft that it is easily scratched by the finger nail. A simple field test is to bite it, noting its softness and freedom from grit. Gypsum, when occurring in large beds, is used to make plaster of Paris, and common wall plaster now so extensively used instead of lime mortar.

CALCITE, CRYSTALLIZED LIME

Calcite is carbonate of lime, and next to quartz is the most common mineral. It consists of 44 parts of carbon dioxide, and 56 parts of lime. It is one of the minerals most useful to man, for all limestones are essentially calcite, and mortars and cements are made of lime. Lime for mortar is made by heating limestone, which drives off the water and gas, leaving quick lime. Hydraulic cement is made by heating impure limestone, the impurities consisting chiefly of sand, clay, and iron. This invaluable building material, cement, has the property of setting under water, hence the name hydraulic cement.

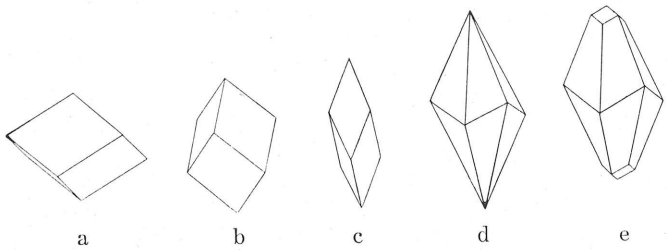


Fig. 16.—Calcite crystals. a, b, and c, rhombohedra of calcite, of common occurrence; c, often called "nail-head" calcite; d, dog-tooth calcite, common; e, dog-tooth calcite with rhombohedral combination.

Calcite is crystallized lime. There are two highly satisfactory tests for calcite. First, the crystals invariably cleave or split easily into tilted cubes. Students in the laboratory speak of these as flattened or "squashed cubes," a name that is highly descriptive. There is no similar mineral in the State with which this can be confused. As a second test, drop a bit in dilute hydrochloric acid or vinegar, and if it foams or effervesces vigorously it is calcite. This is the best means for detecting lime in rock, sand, clay or soil.

DOLOMITE

Dolomite is a double carbonate. That is, it is lime carbonate and magnesium carbonate in nearly equal amounts. Dolomite is not only related to calcite but in many instances resembles it closely. Dolomitic

limestone is not distinguishable by the eye from ordinary limestone, though detected at once by the acid test. Remember that calcite and all limestones effervesce at once in dilute hydrochloric acid, but dolomite will not. Magnesia retards or stops the effervescence.

The following is a very conclusive test: if a bit of the supposed limestone does not effervesce vigorously when dropped into cold hydrochloric acid, reduce it to powder, or heat a bit and put it into the acid. If it effervesces it may be pronounced magnesia or dolomite limestone. The same test can be applied to "Magnesia Soil," so often reported. "Magnesia" seems to be an abused term, especially in central and western Nebraska. The term seems to be applied to every white powdery substance. Most of the so-called magnesia is simply lime. And most of the "Magnesia soil" proves to be lime instead.

ARAGONITE

Aragonite, like calcite, is calcium carbonate in the proportion of carbon dioxide 44 parts to lime 56. Both are deposited from water which carries lime in solution, and both react alike. Then the question naturally arises why are there two names for the same thing. The answer in brief is that they crystallize in different systems, which justifies different specific names. Calcite crystallizes from cold solutions, aragonite from warm. Crystals of calcite are hexagonal, or six-sided, while those of aragonite are tetragonal or four-sided prisms. This

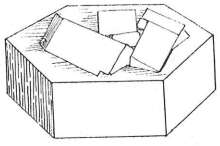


Fig. 17.—Aragonite from Franklin County. The above form is composed of several crystals so twinned together as to imitate a prism in the hexagonal system.

must seem contradictory to the reader who looks at the accompanying figure of aragonite and finds it truly six-sided. But this is a highly interesting deception. In fact it is composed of three crystals twinned together in such a way as to be six-sided. Remember aragonite has very imperfect cleavage, while the cleavage of calcite is perfect. Aragonite is not common like calcite, and its occurrence has been noted in but one spot, Bloomington, in Franklin County.

THE HYDROCARBONS, NATURAL FUEL OIL, COAL AND GAS

Nothing has levied so heavy a tax on the prospectors of Nebraska as the quest for coal, oil, and gas. This levy has exceeded a quarter of a million a year, in spite of the fact that geologists have been warning our people for fifty years that coal, oil, and gas are not to be expected in this region. Men realize how important the natural fuels are to a state minus them, and it is scarcely to be wondered that they are ready to make financial sacrifice for the sake of finding either of these materials. Records of the deep wells in the State indicate that these fuels are wanting.

It is true that there are nearly 35 inches of coal at Peru covering perhaps 20 acres, and that there are beds 12 to 15 inches thick in several places. Our thin beds of coal cannot be worked with profit. It is also true that gas has been struck in several surface wells, but the flow has never lasted more than two or three days. There is no authentic report of petroleum having been struck, not even in the deepest well, the one at Nebraska City, which is a trifle over 3,000 feet deep, nor in the State test well at Lincoln which is 2,463 feet deep. The bounty of $4,000 offered by the State for a bed of workable coal not less than 26 inches thick was awarded to the owners of the Honey Creek mine at Peru. It has been decided, however, that this offer is still open for like discoveries.

The State Geological Survey hopes that men may not be discouraged from drilling and prospecting, for whether their efforts are successful financially or not, information of value is sure to result. It is important to science that drillers of deep wells keep careful records, and that samples be sent to this office, where they will be examined without cost to the sender. Peat as a fuel has value, and many beds have been reported and excellent samples furnished. However, the owners never divulge the location and as yet no good commercial peat bogs are recorded by the Nebraska Geological Survey.

AMBER

Amber is fossil resin. It is well known and much admired in jewelry, particularly in necklaces of graduated beads. In the lignite coals of the Cretaceous formation of Nebraska, numerous small bits of fossil resin are found. Our native amber has no commercial value. Nevertheless, it is worthy of mention, for it has been noticed and commented upon by many. The transparent yellow color of amber is so well known that tests are unnecessary.

The University of Nebraska,
Lincoln, November, 1911.

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